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(54) IMPROVED HIGH STRENGTH AND WATERPROOFED WOVEN SYNTHETIC FABRIC

(71) We, RICHARDS LIMITED, a British Company, of Broadford Works, 62, Maberly Street, Aberdeen, Scotland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a proofed, breathable fabric woven from staple synthetic fibres, and more particularly to such a fabric for use in tarpaulins, tentage or the like.

The expression "proofed" is used herein to describe a fabric which has been treated to render same waterproof, rot and mildew resistant and/or fireproof.

The expression "breathable" is used herein to describe the property of a fabric which allows the passage of air and/or water vapour, but not the passage of water. A fabric possessing this property is often referred to under the Trade Mark "Ventile".

It is well-known in the art to treat a fabric made from natural fibres such as flax or linen to render the fabric proofed. One known waterproofing process is the so-called "dry chemical" proofing process in which a wax emulsion is prepared which contains for example paraffin wax, emulsifying agents such as soaps, stabilizers and thickeners such as locust bean gum, fillers such as china clay, pigments, rot-proofing additives and fixing agents such as aluminium acetate or formate. The fabric to be rendered waterproof is coated with the wax emulsion when it is absorbed in the natural fibres of the fabric. The treated fabric is then dried to remove excess water.

A typical known dry chemical wax emulsion is set out hereafter and comprises two parts:

Part A

7 lbs. Gum Tragon (Trade Mark)
40 lbs. Soap Flakes
10 lbs. Pentachlorophenyl Laurate
100 lbs. Paraffin Wax
made up to 100 gallons with water.

Colour pigments and fillers can be added as required.

The function of the gum tragon is to act as an emulsion stabiliser and thickener. Other materials can be used instead, e.g. Casein, the choice of material being dependent on its ability to function in the above-mentioned manner as well as having little or no adverse effect on the water repellency of the treatment.

Part B

An aqueous solution of aluminium or zirconium salts of low molecular weight carboxylic acids, e.g. formate or acetate. In the case of aluminium formate, an aqueous solution is made up to contain approximately 1% by weight expressed as Al_2O_3 (alumina), but this concentration may be altered to suit the absorbency of the fabric. However, sufficient must be present to form an aluminium "soap" on reaction with the soap flakes as well as break the emulsion in situ when applied to the fabric.

The pentachlorophenyl laurate is present as a rot-proofing agent. One such suitable material is Mystox LPL 100%, "Mystox" being the Registered Trade Mark of Castomance Ltd., 94, Bridge Road East, Welwyn Garden City, Herts. The quantities of the various materials can, of course, be altered to suit the finish required.

The fabric to be treated is passed through

[Price 25p]

a bath containing the wax emulsion (Part A) at approximately 60°C. The excess emulsion is squeezed off by passing the fabric through a padding mangle, thus depositing on the fabric the desired weight of solids. From this the fabric passes through a bath containing Part B (aluminium formate) at approximately 70 to 75°C and allowed to pick up an excess of this solution. The fabric is then finally dried at a minimum temperature of 70°C.

Other methods of application are known in which the same result is achieved, i.e. by pre-treating the fabric with part B and drying, then treating with the wax emulsion and drying. At the same time the treatment can be applied by a single bath process whereby the part B is added to the wax emulsion.

It has been found that the weight addition to the base fabric is up to 40% dry based on the weight of the unproofed fabric depending on the type of finish required.

It is also known to waterproof a fabric woven from the synthetic fibres of a polyester such as "Terylene" (Registered Trade Mark) by using a known "dry chemical" proofing composition. "Terylene" awning canvas has been treated to impart a degree of water repellency so that the awnings on board ships do not absorb rain, sea-spray or dew thus becoming "soggy" and difficult to handle.

However, tentage or tarpaulin canvas made from synthetic fibres has not been treated in this way since it was found necessary to re-treat ship awnings at regular intervals of two or three months. Moreover, ship's awnings are not subjected to continuous flexing, rope abrasion and so forth, which tended to point away from "dry chemical" proofing of tentage and tarpaulins.

One way in which a fabric woven from synthetic fibres such as nylon or "Terylene" can be rendered waterproof is by coating it with P.V.C. (polyvinylchloride). This gives a coated fabric which suffers from the disadvantages that it is relatively heavy (the coating more than doubles the base weight of the fabric in most cases), has a reduced tear strength and is impermeable, so that the coated fabric cannot "breathe".

According to the present invention there is provided a proofed breathable fabric as herein defined which comprises a base fabric woven from staple synthetic fibres which has been treated with a modified dry chemical proofing composition including a plastics emulsion to render the fabric proofed and breathable, the weight addition to the fabric lying in the range 15—40% by weight of the base fabric.

Also according to the present invention there is provided a method of treating a base fabric woven from staple synthetic fibres with a modified dry chemical proofing composition including a plastics emulsion to render the fabric proofed and breathable as herein defined, the

weight addition to the fabric lying in the range 15—40% by weight of the base fabric.

The preferred plastics emulsion is an acrylic plastics emulsion.

Other emulsions which may be used are P.V.C. (polyvinylchloride); P.V.d.C. (polyvinylidenechloride); polyacrylate; butadiene and butadiene/acrylonitrile copolymers; styrene and styrene/butadiene co-polymers; polychloroprene; P.V.A. (polyvinylacetate) and styrene/acrylic co-polymers. With certain of these plastics emulsions it may be desirable to include blocked isocyanates to improve their adhesion.

The invention will now be described further by way of examples.

TABLE 1

The following table gives examples of possible fibre compositions.

100% Polyamide fibre
100% Polyester fibre
100% Acrylic fibre
100% Polyvinyl Alcohol fibre

| Fibre A | Fibre B | |
|---------|---------|-----|
| 90% | 10% | 90 |
| 80% | 20% | |
| 75% | 25% | |
| 70% | 30% | |
| 66⅔% | 33⅓% | |
| 60% | 40% | 95 |
| 55% | 45% | |
| 50% | 50% | |
| 45% | 55% | |
| 40% | 60% | |
| 33⅓% | 66⅔% | 100 |
| 30% | 70% | |
| 25% | 75% | |
| 20% | 80% | |
| 10% | 90% | |

Where fibre A is a polyamide, polyester, acrylic or polyvinyl alcohol fibre, and fibre B is different type of fibre selected from the above list e.g. 90% polyamide, 10% polyester.

It is also possible to use three-way blends of any combination of the above mentioned fibres.

It is preferable to ensure the correct balance between the wax and the plastic emulsions in order to achieve an acceptable fabric performance. Too high a plastic emulsion content will greatly reduce the desirable property of ventility, whereas too high a wax emulsion content will reduce the adhesion factor. The weight addition of the proofing treatment is not to be less than 15% of the weight of the base fabric, and not higher than 40% of the weight of the base fabric.

It has been found necessary with certain

plastic emulsions to apply a final treatment to the dried fabric to obtain best possible properties, e.g. with P.V.C. (polyvinylchloride). The treatment would comprise a final heat treatment at 150°C for approximately 3 minutes.

Example 1

Fabrics selected from table 1 were treated with a two part modified dry chemical wax emulsion proofing comprising:

10 Part A

- 7 lbs Gum Tragon
- 15 lbs Soap Flakes
- 10 lbs Pentachlorophenyl Laurate
- 40 lbs Paraffin Wax
- 15 120 lbs Acrylic plastic emulsion (40% solids)

made up to 100 gallons with water. A suitable pentachlorophenyl laurate is that sold under the Registered Trade Mark Mystox LPL 100% by Catomance Ltd., 94 Bridge Road East, Welwyn Garden City, Herts.

A suitable acrylic plastics emulsion is that sold under the trade name Reventox A272 which is an anionic emulsion of a self cross linking acrylic copolymer.

Pigments and fillers can be added as required.

Part B

An aqueous solution of aluminium or zirconium salts of low molecular weight carboxylic acids, e.g. formate or acetate. In the case of aluminium formate, an aqueous solution is made up to contain approximately 1% by weight expressed as Al_2O_3 , but this concentration may be altered to suit the absorbency of the fabric. However, sufficient must be present to form an aluminium "soap" on reaction with the soap flakes as well as break the emulsion in situ when applied to the fabric.

The fabric to be treated is passed through a bath containing the wax emulsion (Part A) at approximately 60°C. The excess emulsion is squeezed off by passing the fabric through a padding mangle, thus depositing on the fabric the desired weight of solids. From this the fabric passes through a bath containing part B (aluminium formate) at approximately 70 to 75°C and allowed to pick up an excess of this solution. The fabric is then finally dried at a minimum temperature of 70°C.

Example 2

In an alternative two-part emulsion composition, part A comprised

- 7 lbs gum tragon
- 15 lbs Soap flakes
- 10 lbs Pentachlorophenyl laurate
- 40 lbs Paraffin wax
- 100 lbs Polyvinyl acetate emulsion (45% solids)

part B of the emulsion composition and the treatment of base fabric was similar to that outlined in the first example.

Again it was found that the weight addition to the base fabric was 15% to 40%, depending upon the composition of the base fabric.

Other methods of application are known in which the same result is achieved, i.e. by pretreating the fabric with Part B and drying, then treating the wax emulsion and drying. At the same time the treatment can be applied by a single bath process whereby the Part B is added to the wax emulsion.

If any additives have been applied to the yarns and/or fibres, e.g. warp dressing materials which would impair the final water repellency of the fabric, then these would have to be removed prior to proofing. At the same time it may be advantageous to heat-set the fabric prior to proofing to obtain greater dimensional stability, e.g. if high temperature treatments are necessary to obtain maximum water repellency when using say PVC; then heat-setting is of considerable advantage.

If it is desired to impart flame resistance to the fabric to be treated antimony trioxide can be added along with a chlorinated material such as chlorinated paraffin, e.g. "Cereclor" (Trade Mark) 42 which combines with the antimony trioxide when a flame is applied to form antimony oxychloride, a known effective flame retardant. In this case, the paraffin wax is not included but is replaced with the chlorinated paraffin.

Table 2 set out hereafter gives the physical data for an all synthetic fabric treated with the modified dry chemical wax emulsion of the present invention as compared with flax and cotton fabrics treated with a known dry chemical wax emulsion and P.V.C. coated nylon (polyamide).

TABLE 2

| | All synthetic fabric treated with modified Dry chemical Wax Emulsion | All flax fabric treated with conventional Dry chemical Wax Emulsion | All cotton fabric treated as all flax | PVC coated nylon |
|---|--|---|---------------------------------------|--------------------------------------|
| Composition | 80% nylon 20% polyester | 100% flax line | 100% cotton | 100% nylon continuous filament |
| Weight "Unproofed" | 12.0 | 16.0 | 15.0 | 5.0 |
| "Proofed" | 15.0 | 19.5 | 20.0 | 17.0 |
| Weave | Plain | Plain | Plain | Plain |
| Threads/inch "Proofed" warp | 50 | 38 | 44 | — |
| weft | 36 | 36 | 32 | — |
| Breaking Load (1) "Proofed" warp | 750 | 460 | 333 | 700 |
| lbs/square inch weft | 650 | 600 | 299 | 480 |
| Tear Strength (2) "Proofed" warp | 130 | 90 | 31 | 115 |
| lbs. weft | 105 | 75 | 23 | 95 |
| Hydrostatic Head (3) cms. head water | | | | |
| "Proofed" as rec'd | 89 | 72 | 60 | — |
| after crushing (4) | 67 | 38 | 45 | — |
| after crushing and steeping (5) | 60 | 43 | 47 | — |
| after weatherometer exposure (6) | 80 | 47 | 64 | — |
| Weatherometer Shrinkage (7) warp | 3.0% | 9.0% | 6.0% | — |
| weft | 0.5% | 2.5% | 1.5% | — |
| Moisture Vapour Transmission (8) grams/m ² /24 hrs. | 150 | 620 | 540 | — |

The references set out in Table 2 are as follows:—

- (1) *Breaking Load*—BS.2576 1959. Constant rate of traverse of $4\frac{1}{2}$ " /min.
- (2) *Tear Strength* — Linen Industries Research Association Test method in British Standards Handbook No. 11 1956 page 167.
- (3) *Resistance to water penetration* — Hydrostatic Head Test—BS.2823 1957.
- (4) *Crushing*—A sample 6" square is gripped at opposite edges by the hands which are then revolved in such a manner that the surface of the fabric is rubbed against itself and thoroughly crumpled and flexed.

- (5) *Crushing & Steeping* — The sample is then prepared as for crushing ref, (4), then immersed in water at 60°C which is then allowed to cool at room temperature for four hours. The Sample is then dried and conditioned prior to testing.
- (6) and (7) *Weatherometer Exposure* — A sample 12" x 12" which contains a marked 10" square on one side for shrinkage measurements, is exposed in the weatherometer to the following cycle

| | | | |
|----|-------|--|--|
| | 0—2 | hrs. carbon arc lamps on only | |
| | 2—4 | " " " " " and water sprays on | |
| | 4—6 | " " " " " off, but sprays left on | |
| | 6—8 | " " " " " on only—sprays off | |
| 5 | 8—10 | " as for 2—4 hrs. | |
| | 10—12 | " as for 4—6 hrs. | |
| | 12—14 | " as for 6—8 hrs. | |
| | 14—16 | " as for 2—4 hrs. | |
| | 16—18 | " as for 4—6 hrs. | |
| 10 | 18—23 | " carbon arc lamps on only to dry off samples ready for daily inspection during 24th hour. | |

This 23-hours cycle is repeated for 15 days at the end of which shrinkage measurements and hydrostatic head tests are carried out.

15 (8) *Moisture Vapour Transmission* — Test Method in accordance with Appendix E of BS. 1133 Section 7, 1952, Standard Method A.

20 It will be seen that an all synthetic fibre treated with the modified dry chemical proofing process of the invention results in a fabric which has a high strength related to low weight; has a degree of waterproofness which would comply with the accepted requirements of such fabrics; has a high inherent degree of rot-proofness; remains more flexible when wet or under climatic extremes than natural fibres processed either by conventional "dry chemical" methods or by the modified method referred to; has superior abrasion and wear resistance; has a minimal shrinkage factor; and does not "open out" in use as would a flax fabric.

35 WHAT WE CLAIM IS:—

1. A proofed breathable fabric as herein defined which comprises a base fabric woven from staple synthetic fibres which has been treated with a modified dry chemical proofing composition including a plastics emulsion to render the fabric proofed and breathable, the weight addition to the base fabric lying in the range 15—40% by weight of the base fabric.

2. A proofed breathable fabric as claimed in claim 1 in which the modified dry chemical proofing composition includes an acrylic plastics emulsion.

3. A proofed breathable fabric as claimed in claim 1 in which the modified dry chemical proofing composition includes a P.V.C. (polyvinylchloride), P.V.d.c. (polyvinylidene chloride), polyacrylate, butadiene, and/or butadiene/acrylonitrile co-polymers, styrene and/or styrene/butadiene co-polymers, polychloro-

prene, P.V.A. (polyvinylacetate) or styrene/acrylic copolymers.

4. A proofed breathable fabric as claimed in any one of claims 1 to 3 in which the base fabric is 100% polyamide, 100% polyester 100% acrylic or 100% polyvinyl alcohol fibre.

5. A proofed breathable fabric as claimed in any one of claims 1 or 3 in which the base fabric is a blend of two types of fibres selected from polyamides, polyesters, acrylics or polyvinyl alcohol fibres comprising from 10% to 90% of one of said types of fibres together with from 90% to 10% of the other type of fibre.

6. A method of treating a base fabric woven from staple synthetic fibres with a modified dry chemical proofing composition including a plastics emulsion to render the fabric proofed and breathable as herein defined the weight addition to the fabric lying in the range 15—40% by weight of the base fabric.

7. A method as claimed in claim 6 in which the dry chemical proofing composition includes an acrylic plastics emulsion.

8. A method as claimed in claim 6 in which the dry chemical proofing composition includes a P.V.C. (polyvinylchloride), P.V.d.c. (polyvinylidene chloride), polyacrylate, butadiene, and/or butadiene/acrylonitrile co-polymers, styrene and/or styrene/butadiene copolymers, polychloroprene, P.V.A. (polyvinylacetate) or styrene/acrylic copolymers.

9. A method as claimed in any one of claims 6 to 8 in which the proofing is carried out in two stages.

10. A proofed breathable fabric substantially as hereinbefore particularly described with reference to the accompanying examples.

11. A method of treating a base fabric woven from staple synthetic fibres substantially as hereinbefore particularly described with reference to the accompanying examples.

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